Advanced Materials and Manufacturing for Low-Cost, High-Performance Liquid Rocket Combustion Chambers, Phase II

Completed Technology Project (2004 - 2006)

Project Introduction

Silicided niobium alloy (C103) combustion chambers have been used extensively in both NASA and DoD liquid rocket propulsion systems. Niobium alloys offer a good combination of temperature capability, density, and cost, while the silicide coating has been successful in providing moderate oxidation resistance and use temperature. However, for many current applications the silicide coating is now proving to be the limiting factor in achieving the required chamber performance and/or lifetime, and the chamber manufacturing cost is excessive. NASA is seeking advanced bipropellant propulsion systems for Earth science spacecraft and space exploration vehicles, while DoD is seeking economical and high-performance bipropellant thrusters for liquid divert and attitude control systems in kinetic energy kill vehicles for ballistic missile defense (a high-volume application). These goals cannot be achieved using standard silicided C103 chambers. In this project, Ultramet proposes to develop and demonstrate a combustion chamber with substantially improved manufacturability, cost, and performance. In Phase I, Ultramet successfully demonstrated both improved chamber manufacturing and a more robust and higher performance oxidation-resistant coating as a replacement for the silicide. This was accomplished through a unique manufacturing process involving low temperature spray deposition of C103 on removable plastic mandrels produced by rapid prototyping. Thin vapor-deposited platinum coatings were shown to substantially improve oxidation resistance relative to the standard silicide coating. In Phase II, Ultramet will expand upon the Phase I results by performing a comprehensive optimization of the combustion chamber processing including mandrel development, cold-spray material/process optimization, and oxidation-resistant coating optimization. Performance will then be demonstrated through hot-fire testing.

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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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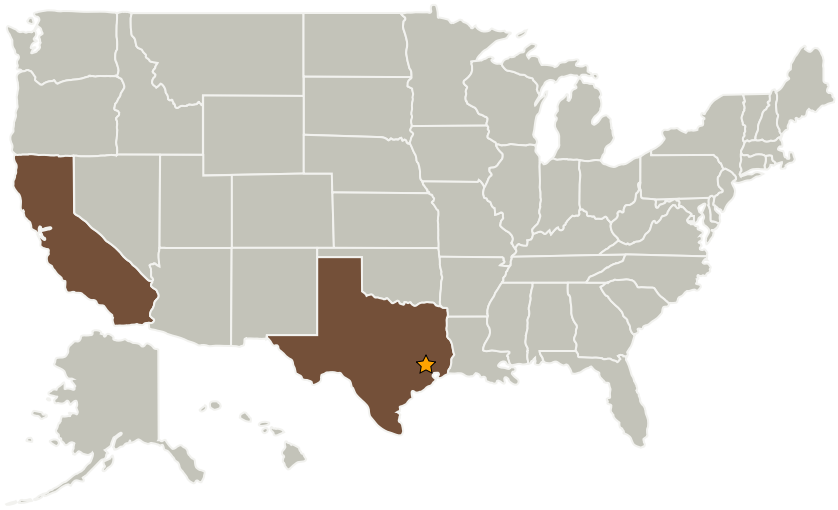
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Ultramet	Supporting Organization	Industry	Pacoima, California

Primary U.S. Work Locations	
California	Texas

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.3 Cryogenic